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[Claims]

[Claim 1] A remote controller comprising operation means for enabling input of an operation signal with an operation at a predetermined position on the circumference of its substantially circular shape; detection means for detecting the input to the operation means, and output means for deriving an operating instruction given to the operation means based on the detection result from the detection means.

[Claim 2] The remote controller according to claim 1 further comprising display means provided inside the substantially circular shape of the operation means, wherein the operating instruction or the like is made displayable on the display means.

[Claim 3] The remote controller according to claim 1 further comprising an annular- or ring-shaped display means provided around the outer periphery of the circular shaped operation means, wherein the operating instruction or the like is made displayable on the display means.

[Claim 4] The remote controller according to claim 1, wherein the detection means comprises a sensor for detecting an operation on the operation means so that it will detect the operation at a pressed position corresponding to one of plural areas divided on the circumference of the operation means and output a corresponding signal.

[Claim 5] The remote controller according to claim 1 or 4, wherein the detection means comprises a plurality of sensors, and the output means calculates each of detection signals from the sensors, whereby the remote control has resolution for detection signals larger in number than the number of sensors so that it can discriminate between a press on the circumference of the operation means and sliding motion while holding pressed down or the sliding speed to derive the operating instruction.

[Detailed Description of the Invention]

[0001]

[Industrial Field of Application] The present invention relates to a remote controller for video equipment and the like.

[0002]

[Prior Art] Many of conventional remote controllers for TV, VTR, etc. have an operation part with ten or twelve keys individually for selecting each channel or time setting of a timer. These keys are often arranged in a 4×3 matrix.

[0003] On the other hand, simplified remote controllers without the above keys are equipped with UP/DOWN keys for channel selection or volume control.

[0004] However, users who are not familiar with the ten or twelve keys need to keep in mind the positional relation of the respective ten or twelve keys. Therefore, if the users cannot remember clearly the positional relation, they have to do cumbersome work of operating keys while seeing the remote controller to check the position of the ten or twelve keys each time to select a channel. In other words, the users have to repeat seeing the remote controller, the TV screen, and the remote controller again to change the channel to another station, and this causes a problem of making the user tired of such cumbersome operations. Further, when operating the TV set or VTR in a dark room without light, the users cannot check the position of the ten or twelve keys, and this causes another problem of making it difficult to operate the controller.

[0005] The controllers provided with the UP/DOWN keys are convenient because of no need to check the operational position, but it is impossible to directly select a receive channel. For example, when changing from position 1 to position 12, the users have only to press the DOWN key once, but when changing from position 1 to position 7, they have to press the UP key six times. Thus, this type of controllers requires plural operations and hence causes a problem of taking time and effort.

[0006]

[Problems to be Solved by the Invention] As discussed above, the conventional remote controllers provided with the ten or twelve keys require users to keep in mind the relationship among those positions, making intuitive operation impossible. On the other hand, the controllers provided with the UP/DOWN keys require plural operations to get a

desired position.

[0007] It is an object of the present invention to provide a remote controller intuitively operable as if to operate a clock or watch by providing a circular operation part divided into twelve areas like those for the hands of the clock or watch to eliminate the need to check the positional relation on the operation part so as to enable direct selection of a receive channel.

[0008]

[Means for Solving the Problems] In order to attain the above object, a remote controller according to a first aspect of the present invention includes: operation means for enabling input of an operation signal with an operation at a predetermined position on the circumference of its substantially circular shape; detection means for detecting the input to the operation means; and output means for deriving an operating instruction given to the operation means based on the detection result from the detection means.

[0009] According to a second aspect of the present invention, the remote controller further includes display means provided inside the substantially circular shape of the operation means, wherein the operating instruction or the like is made displayable on the display means.

[0010] According to a third aspect of the present invention, the remote controller further includes annular- or ring-shaped display means around the outer periphery of the circular shaped operation means, wherein the operating instruction or the like is made displayable on the display means.

[0011] According to a fourth aspect of the present invention, the remote controller is such that the detection means includes a sensor for detecting an operation on the operation means so that it will detect the operation at a pressed position corresponding to one of plural areas divided on the circumference of the operation means and output a corresponding signal.

[0012] According to a fifth aspect of the present invention, the remote controller is such

that the detection means includes a plurality of sensors and the output means calculates each of detection signals from the sensors, whereby the output means has resolution for detection signals larger in number than the number of sensors so that it can discriminate between a press on the circumference of the operation means and sliding motion while holding pressed down or the sliding speed to derive the operating instruction.

[0013]

[Operation] The remote controller according the first aspect of the present invention includes: operation means for enabling input of an operation signal with an operation at a predetermined position on the circumference of its substantially circular shape; detection means for detecting the input to the operation means; and output means for deriving an operating instruction given to the operation means based on the detection result from the detection means. Since the operation part is divided into twelve areas like those for the hands of the clock or watch so that users can operate each of the areas to enter an operating instruction, the users can intuitively operate the controller without much concern for the respective operating positions, making it easy for the users to operate.

[0014] The remote controller according to the second aspect of the present invention further includes display means provided inside the substantially circular shape of the operation means so that the operating instruction or the like will be displayed on the display means. This structure provides operational guidance on the display means, thereby preventing operation errors and allowing users to intuitively operate the controller.

[0015] The remote controller according to the third aspect of the present invention further includes annular display means provided around the outer periphery of the circular shaped operation means, wherein the operating instruction or the like is displayed on the display means. As mentioned above, this structure also provides operational guidance on the display means, thereby preventing operation errors and allowing users to intuitively operate the controller.

[0016] The remote controller according to the fourth aspect of the present invention is such that the detection means includes a sensor supporting the operation part so that it will detect an operation at a pressed position corresponding to one of plural areas divided on the circumference of the operation means and output a corresponding signal. This structure allows users to operate the controller with an image of the movement of clock hands in their heads, and hence to directly select a receive channel without much concern for the respective operating positions.

[0017] The remote controller according to the fifth aspect of the present invention is such that the detection means includes a plurality of sensors and the output means calculates each of detection signals from the sensors, whereby the output means has resolution for detection signals larger in number than the number of sensors so that it can receive the input of the signals as continuous input points and discriminate between a press on the circumference and sliding motion while holding pressed down or the sliding speed to derive the operating instruction. This structure allows users to intuitively operate the controller with an image of the movement of clock hands in their heads, and hence to directly select a receive channel without much concern for the respective operating positions, making the operation easy.

[0018]

[Embodiments] Referring to the drawings, preferred embodiments of the present invention will be described below. FIG. 1 is a perspective view showing a remote controller according to a preferred embodiment of the present invention. As shown in FIG. 1, an annular- or ring-shaped operation part 7 and a display part 9 using a liquid crystal panel (LCD) arranged in the central portion of the ring shape of the operation part 7 are provided on a case 1 of the remote controller. When an outer peripheral portion of the display part 9 or the ring-shaped operation part 7 is lightly pushed down, the operation part 7 inclines. A plurality of sensors are internally coupled to the operation part 7 to detect the inclination direction so that an operating instruction from a user can

be detected. Based on the detected operating instruction, a function mark or an instruction mark can be displayed on the display part 9. For example, the receive channel or the timer setting such as the clock time or the like is displayed on the display screen.

[0019] A power switch 5 for turning the power of a controlled equipment on and off, and a TV/VTR (television/video tape recorder (recording and playback apparatus)) select switch 3 are provided at the top of the case 1. In addition to these switches, six auxiliary operation keys are provided. When the TV/VTR select switch 3 is operated, the operation mode can be changed to a TV or VTR mode. For example, when the TV mode is selected, the six operation keys function as follows: a key switch 11 as a Vol-UP (volume-up) key, a key switch 13 as a Vol-DOWN (volume-down) key, a key switch 21 as a ch-UP key (for changing the channel in a channel number increasing direction), a key switch 19 as a ch-DOWN key (for changing the channel in a channel number decreasing direction), a key switch 15 as a next-function select key, and a key switch 17 as a selection confirming key.

[0020] On the other hand, when the VTR mode is selected, the key switch 11 functions as a REW (rewind) key, the key switch 13 as a Slow-REW (slow rewind) key, the key switch 21 as an FF(fast-forward) key, the key switch 19 as a Slow-FF (Slow fast-forward) key, the key switch 15 as a PLAY (playback) key, and the key switch 17 as a STOP key. These six operation keys give users more choices when using the controlled equipment. Note that these keys are set in a like manner upon recording.

[0021] FIGS. 2(A) and 2(B) are schematic views showing examples of display on the display part of the remote controller shown in FIG. 1.

[0022] When the operation part 7 is used to directly select a channel, for example, channel 4, a position labeled "4" on the ring shape of the operation part 7 is pressed. Immediately following the operation, an instruction mark indicating the position "4" is displayed as shown in FIG. 2(A), and a channel selection instruction is given to the TV

set using a remote control signal, thereby changing the TV channel. FIG. 2(B) shows another display example of the display part 9 when channel 10 is selected in a like manner.

[0023] FIG. 3 is a perspective view for explaining a case when the remote controller of FIG. 1 is changed to the TV mode.

[0024] When changing the TV channel, the user operates the TV/VTR select switch 3 to set the TV mode, and presses any position on the right half of the ring shape of the operation part 7 which assumes a channel function. With this operation, a channel selection display appears on the display part 9 as shown in FIG. 2(A). Next, the user can press a position corresponding to a desired channel in the same manner as mentioned above to directly select the channel. An infrared (IR) code is automatically transmitted from the remote controller to the TV set to turn the TV set to the channel selected. In this operation, if the user presses a position on the right half of the operation part 7 twice in a short time, that is, double-clicks on the position, the display screen on the display part 9 remains intact as shown in FIG. 3. In other words, positions "1", "2" and positions "4", "5" function as the channel Up keys and the channel Down keys, respectively, unless no key input is received for a predetermined period of time.

[0025] FIGS. 4(A) to 4(D) are schematic views showing examples of display on the display part of the remote controller according to the present invention. FIGS. 4(A) and 4(B) show a case when the volume is controlled. FIGS. 4(C) and 4(D) show a case when time setting is performed, such as to program recording start and end times or to set TV-ON time.

[0026] In the case of volume control, the user presses any position on the left half of the operation part 7 that assumes a "Vol" function in the same manner as mentioned above. With this operation, a Vol control display as shown in FIG. 4(A) appears on the display part 9. Next, the user can press a desired volume position in the same manner as mentioned above to directly control the volume. An infrared (IR) code is automatically

transmitted from the remote controller to the TV set to control the volume level of the TV speaker. In this operation, if the user double-clicks on a position on the left half of the operation part 7, positions "11", "10" and positions "8", "7" function as the Vol-UP keys and Vol-DOWN keys, respectively, during a predetermined period of time.

[0027] In the TV mode, when any position on the left half of the ring shape of the operation part 7 is pressed, the volume display screen is displayed as shown in FIG. 4(A). Further, in FIG. 3, if the central portion of the LCD 9 rather than any position on the operation part 7 is pressed, a next-function selection is made and a time setting screen appears as shown in FIG. 4(C). When this central portion corresponding to the function select switch is pressed sequentially, a function menu screen takes a round, and if there is no input for a predetermined period of time, it goes back to a previous screen (which can be set as the initial screen). Alternatively, the function can also be changed in the same manner by pressing the "function select" button shown in FIG. 3.

[0028] The operating instruction is detected as follows: Only when the "presence of an operating instruction" is detected in all the positions on the ring-shaped operation part by pressing the central portion of the LCD 9, the operating instruction is determined to be that for next-function selection and a corresponding display is provided. Here, the case when the "presence of an operating instruction" is detected in all positions on the ring-shaped operation part means that a substantially equal pressure is applied to four devices in a pressure sensor having 2×2 devices to be described later.

[0029] FIGS. 5(A) to 5(E) are schematic views showing an example of display on the display part during time setting such as to program recording start and end times.

[0030] The following describes VTR programming or setting of TV ON/OFF times using the remote controller of FIG. 1.

[0031] For example, suppose that the start time is 9:00 AM and the end time is 11:20 PM. In this case, The AM/PM indicators are alternated by pressing position "12" on the operation part 7 with a finger. For example, when the current time is in AM (before

noon), the AM indicator is changed to PM by double-clicking on the position "12" of the ring-shaped operation part.

[0032] After setting AM or PM, the start time is set. The ring-shape operation part 7 allows the user to set twelve positions in increments of five minutes. First, in FIG. 5(A), the display part 9 shows [Start hour?] and stays waiting for an operating instruction. In this condition, if the user presses position "9" on the operation part 7, then 9:00 is set as the start hour. Immediately following this setting, long and short hands of a clock or watch appear on the display part 9 as shown in FIG. 5(A). Then, in FIG. 5(B), if the user presses position "12" to set the start minute, 0 minute is set and the clock hands point to 9:00. After that, the display part 9 shows [End hour?] as shown in FIG. 5(C) to guide the setting of the end time.

[0033] Next, the user sets the end time. After the AM/PM setting is done in the same manner as mentioned above, the user presses position "11" in FIG. 5(C) to set the end hour. Immediately following this setting, the long and short clock hands appear on the display part 9 to indicate 11:00 as shown. Then, in FIG. 5(D), when the user presses position "4" to designate the end minute, the clock hands point to 11:20 on the display part 9, and a recording time confirmation display appears as shown in FIG. 5(E). In the recording time confirmation display, the start and end times are shown in a character string, while the total recording time is graphically shown in a fan-like shape.

[0034] FIG. 6 is a perspective view when the remote controller of FIG. 1 is in the VTR mode.

[0035] The operation part 7 can also be used to operate the VTR. In this case, as shown, the positions "12", "3", "6", and "9" on the operation part 7 are brought into correspondence with PLAY (triangle mark), FAST-FORWARD (double-triangle mark), STOP (square mark), and REWIND (reversed double-triangle mark), respectively, so that the user can press the respective positions to directly operate the VCR. Icons corresponding to the (triangle mark), (double-triangle mark), (square mark), and

(reversed double-triangle mark), respectively, are shown in corresponding positions on the liquid crystal panel of the display part 9 to guide the user's operations more reliably.

[0036] Thus, in addition to the use of the ring-shaped operation part 7 divided into twelve areas like those for the hands of a clock or watch, the indications corresponding to the respective operations are displayed on the liquid crystal panel of the display part 9 provided inside the ring shape of the operation part 7. This allows the user to intuitively operate the controller with an image of a familiar clock in his or her head without being disturbed by the ten or twelve keys. Further, since the operation part 7 has the round-ring shape, the user can roughly detect a channel or time position quickly even in the dark. Instead of the round-ring shape, the operation part 7 can be formed into a polygonal shape more than a triangle. The indications on the liquid crystal panel of the display part 9 are auxiliary indications that make the user's operations more certain in an interactive manner. Of course, an on-screen display can also be provided on the TV or VTR side.

[0037] FIG. 7 is a perspective view showing an exemplary structure of the operation part of the remote controller according to the present invention, and FIG. 8 is a side view of FIG. 7.

[0038] The ring-shaped operation part 7 is connected to a rigid plate 37 through four supporting legs 31 of the operation part, and the rigid plate 37 is connected to a pressure sensor 43 having 2×2 devices through four supporting rubber legs 41. Thus, since the operation part 7 is supported by the pressure sensor 43, an operating instruction, that is, a mechanical pressure applied to the ring-shaped operation part 7 is transmitted indirectly to the pressure sensor 43. In the pressure sensor 43, the mechanical pressure is converted to a change in electric resistance, and further to a change in voltage by driving current from an external constant current source. The voltage change is output via an output signal line 45 of the pressure sensor.

[0039] On the other hand, the display part 9 is made up of a transparent panel 29 and a

liquid crystal panel 33 placed underneath the transparent panel 29. The liquid crystal panel 33 is suspended between the operation part 7 and the rigid plate 37 by means of liquid crystal panel supporting legs 35 independently of the operating instruction detecting mechanism. However, if the external force does not affect the functionality of the liquid crystal panel, the liquid crystal panel does not need to be of independent suspension structure and can be connected directly to the operation part.

[0040] A display is provided on the liquid crystal panel 33 based on display data input through a signal input line 39 of the liquid crystal panel.

[0041] Thus, using four or more devices as the pressure sensor 43, the operating instruction given to the operation part 7 is detected, and the detected signal is output via the output signal line 45 of the pressure sensor. Then using, for example, a microprocessor or the like, operational display data are read from a memory according to the output, and input into and displayed on the liquid crystal panel 33 through the signal input line 39 of the liquid crystal panel.

[0042] FIG. 9 is a circuit block diagram showing the main part of the remote controller according to the embodiment of the present invention, and FIG. 10 is a schematic view showing the hardware structure of a signal processing part.

[0043] The operating instruction given to the operation part 7 is transmitted to the pressure sensor 43 having 2×2 devices Xk, Xr, and Yu, Yk in the horizontal and vertical directions, and respective values Xk, Xr, and Yu, Yk are output from the devices as voltage values, respectively. The voltage values output from the pressure sensor 43 are led into a multiplexer 51 respectively, and quantized by an A/D converter 53 in a time-sharing manner. Then, in a signal processing part 69, an X-directional (horizontal) indicating amount detection part 55 and a Y-directional (vertical) indicating amount detection part 57 detect indication amounts in these directions, respectively, from the output of the A/D converter 53, and a indicating direction detection part 59 calculates the indicating direction to input the calculation result into the display selecting/switching part

63.

[0044] Then, based on the input from the indicating direction detection part 59, the display selecting/switching part 63 selects or switches to display data to be displayed on the liquid crystal panel 33 in a text format or graphical pattern, not only to supply the display data to a display screen constructing part 65, but also to input data into an IR code constructing part 67 for constructing an infrared (IR) code specific to the remotely controlled TV set or VTR.

[0045] The display screen constructing part 65 constructs a driving signal for driving the liquid crystal panel 33 and a display pattern to output them to the liquid crystal panel 33. The IR code constructing part 67 constructs the infrared (IR) code and transmits the constructed IR code to the controlled TV set or VTR through an IR code transmitter to control the operation of the controlled equipment.

[0046] FIG. 10 is a schematic view showing an example of the hardware structure of the signal processing part 69 shown in FIG. 9. Referring to FIG. 10, the signal processing part 69 includes a microprocessor 71, a ROM 73, and a working RAM 75. The output of the A/D converter 53 is input into and computed by the microprocessor 71 according to a control program stored in the ROM 73. In the computation process, the microprocessor 71 refers to data stored in the ROM 73 and the working RAM 75 to output the driving signal for driving the liquid crystal panel 33 or the IR code signal based on the computation results.

[0047] FIG. 11 is a flowchart for explaining the operation of the remote controller according to the present invention, taking as an example a case where the remote controller is in the TV mode as shown in FIG. 3 and the user selects channel 4. Before the channel operation, an output display pattern for the liquid crystal panel (LCD) is read in step S1 from a ROM in the display selecting/switching part 63 shown in FIG. 9, and a display as shown in FIG. 2 is provided in step S3 on the liquid crystal panel 33 according to the read data.

[0048] In step S5, output voltage values Xk, Xr and Yu, Yk respectively from the pressure sensor 43 are captured through the A/D converter 53, and difference operations (Xk-Xr) and (Yk-Yu) are performed to detect operation indicating amounts in the X and Y directions in steps S7 and S9, respectively. Then, from the results in steps S7 and S9, an indicating direction is calculated in step S11. In step S13, the presence or absence of input from the operation part 7 is detected based on the output of S11, and if there is no new input for a predetermined period of time, the procedure returns to step S5.

[0049] Here, as shown in FIG. 2, suppose that the user presses a position labeled "4" corresponding to channel 4 on the ring shaped operation part 7. With this operation, an operating instruction result, indicating that "4" has been pressed, is obtained through the processing steps S5 to S11. Then, when the operation indicating amounts are detected in steps S7 and S9, or when the instruction is given simultaneously to all the pressure sensor devices, it is determined in step S13 that there is input of the operating instruction. In this case, based on the indicating direction obtained in step S11, the procedure proceeds to step S15.

[0050] In step S15, the presence or absence of a mode change is determined based on whether the function select key is pressed, or whether an external force like double-clicking is applied simultaneously to all the pressure sensor devices. Detection of a double click is made when it is detected in step S15 that the operation part is pressed twice in a short time in a loop of steps S5 to S27. If there is a mode change, the operation mode is changed to a new mode in step S29, and the procedure returns to step S3 to repeat the same sequence of operations. If there is no mode change, the procedure proceeds to step S17.

[0051] In step S15, if there is no change from the previous data, the operation mode is confirmed in step S17, and pattern data for the liquid crystal display is input in step S19 from the display selecting/switching part 63 of FIG. 9 to the display screen constructing part 65 to construct a liquid crystal display pattern.

[0052] Then, based on the constructed liquid crystal display pattern, the liquid crystal panel 33 is driven in step S21 to display an indication with a pointer pointing to the selected channel "4" as shown in FIG. 2(A). Further, in steps S23 and S25, IR code data for tuning the TV set to channel 4 is input from the display selecting/switching part 63 to the IR code constructing part 67 to construct and output an IR code to the controlled TV set through the IR code transmitter, thereby turning the TV set to channel 4. Thus, the procedure for operating the operation part 7 of the remote controller through the above sequence of operations to change the controlled TV set to a desired channel is completed.

[0053] In the process to detect the operating instruction, it is assumed that the ring-shaped operation part 7 and the rigid plate 37 connected to the operation part 7 are round or circular in outer shape. If the pairs of sensor devices Xk, Xr and Yu, Yk detect changes corresponding to an instruction independently of each other, the changes in the X (horizontal) and Y (vertical) directions, respectively, are given by:

$X=Xr-Xk$

$Y=Yu-Yk$

Note that, if the pair of sensor devices Xr, Xk, or Yu, Yk are actuated in conjunction with each other to output each difference value, the output in the Y (vertical) direction and the output in the X (horizontal) direction have output values twice as large as those in the above case.

[0054] FIG. 12 is a schematic view for explaining a method of detecting an operated position on the operation part 7. It is assumed that the ring-shaped operation part 7 is circular with a radius value of "1" equivalent to a full-scale value of the output of the pressure sensor 43 in the X or Y direction.

[0055] An indication of the operated position, generated by pressing any position on the ring-shaped operation part 7, is located somewhere on the circumference. If the indication detection result in the X direction is α, the indication detection result in the Y direction is β, and the angle of the indicating direction from the position "12" on the ring

shape is θ, θ can be represented by the following equation where $\alpha<1$ and $\beta<1$:

[0056]

[Eq. 1]

$\theta=90°-\tan^{-1}[(\beta \cdot Fy)/(\alpha \cdot Fx)]$

Since Fx and Fy are full-scale values in the X and Y directions,

$Fy=Fx=1$.

Therefore,

$\theta=90°-\tan^{-1}(\beta/\alpha)$.

The possible results of calculating the equation are prestored in the ROM. In other words, data indicative of indicating directions θ to the ring-shaped operation part 7 are stored at memory addresses of the ROM 73 in FIG. 10. The memory addresses correspond to the values represented by β/α or the values of α and β. Then, in the process of computations performed by the microprocessor 71, a corresponding calculation result is read so that one of the values of the twelve positions, which corresponds to the operated position on the ring-shaped operation part 7, can be obtained.

[0057] FIGS. 13 and 14 are circuit block diagrams showing the main part of a remote controller according to another embodiment of the present invention. FIG. 15 illustrates an exemplary case where a user's finger slides on the ring-shaped operation part 7 to give an operating instruction as shown in FIG. 4. Since the basic structure is substantially the same as that in the aforementioned embodiment, portions having the same functions as those in the aforementioned embodiment are given the same reference numerals, omitting repeated description thereof.

[0058] In FIG. 13, an indicating angle calculation part 61 is added to the structure of FIG. 9 to detect a continuous variation of indicating angle from the output of the indicating direction detection part 59. In other words, a continuation of instruction given to the operation part 7 and the speed of indicating movement are detected and supplied to the display selecting/switching part 63 together with the output of the

indicating direction detection part 59. This allows the user to perform a sliding operation more easily and more intuitively. The structure of FIG. 13 is the same as that of FIG. 10, except that changes are made to the data stored in the ROM 77 in cooperation with the operation of the indicating angle calculation part 61.

[0059] FIG. 15 is a flowchart showing the operation of the remote controller of FIG. 13. A point different from FIG. 9 is that step S31 is inserted between step S17 and step S19 in dealing with adding the indicating angle calculation part 61.

[0060] In FIG. 13, an operating instruction given to the ring-shaped operation part 7 is transmitted to the pressure sensor 43 having 2×2 devices Xk, Xr and Yu, Yk, to output values of Xk, Xr and Yu, Yk as voltage values, respectively. The voltage values output from the pressure sensor 43 are led into the multiplexer 51, respectively, and quantized by the A/D converter 53 sequentially in a time-sharing manner. The X-directional (horizontal) indicating amount detection part 55 and the Y-directional (vertical) indicating amount detection part 57 detect indicating amounts in these directions, respectively, from the output of the A/D converter 53, and the indicating direction detection part 59 calculates the indicating direction. Further, the indicating angle calculation part 61 detects a continuous variation of indicating angle from the output of the indicating direction detection part 59 to input the amount of variation to the display selecting/switching part 63 together with the output of the indicating direction detection part 59.

[0061] In FIG. 15, the remote controller is in the TV mode as shown in FIG. 3. The following describes a case where the user controls the TV volume, that is, operates the "Vol" function with reference to FIGS. 4(A) and 4(B).

[0062] Before the channel operation, the display selecting/switching part 63 reads in step S1 an output display pattern for the liquid crystal panel from a ROM 77 to provide in step S3 a display as shown in FIG. 4(A) on the liquid crystal panel 33b according to the read data. Then, in step S5, output voltage values Xk, Xr and Yu, Yk respectively from

the pressure sensor 43 are captured through the A/D converter 53, and difference operations (Xk-Xr) and (Yk-Yu) are performed to detect operation indicating amounts in the X and Y directions in steps S7 and S9, respectively. After that, from the results in steps S7 and S9, an indicating direction is calculated in step S11. In step S13, the presence or absence of input from the operation part 7 is detected based on the output of S11, and if there is no new input for a predetermined period of time, the procedure returns to step S5.

[0063] When controlling the volume directly, the user first presses any operating position on the left half of the ring-shaped operation part 7 that assumes the "Vol" function. With this operation, an operating instruction result, indicating that the "Vol" function is selected in steps S5, S7, S9, and S11, is obtained. In the following procedure, it is determined in step S13 that there is input of an operating instruction and in step S15 that there is a mode change, so that the operation mode is changed in step S29 to change the function to a "Vol" specific function. After that, the procedure returns to step S3 to provide a volume control display on the liquid crystal panel 33 as shown in FIG. 4(A).

[0064] Next, the user slides his or her finger on the ring-shaped operation part 7 to a desired volume position. For example, if the user wants a middle-level volume, the user slides his or her finger on the ring-shaped operation part from position "12" to position "6" while lightly pressing the ring-shaped operation part.

[0065] This user's operating instruction is repeatedly detected in steps 5 to S15. In other words, it is determined in step S15 whether the function select key is pressed again, or whether a double click on the central portion of the display part is detected from all the devices of the pressure sensor, to determine the presence or absence of a mode change based on the indicating direction obtained in step S11. If there is no mode change, the operation mode is fixed in step S17, and a continuation of the operating instruction is detected in step S31. In other words, if there is a change in the operating instruction for

a predetermined period of time, data on the operating instruction is updated in step 31 to calculate the degree of the indicating angle in association with the previous data detected in a loop of steps S5 to S27. Detection of a double click is made when it is detected in step S15 that the operation part is pressed twice in a short time in the loop of steps S5 to S27.

[0066] In step S19, a liquid crystal display pattern is constructed, and based on the constructed display pattern, the liquid crystal panel 33 is driven in step S21 to provide a display indicating an operating instruction corresponding to "Vol"=6 in the form of a fan-like graphical pattern as shown in FIG. 4(B) or a numeric value. Further, in step S23, an IR code corresponding to the volume level is constructed, and in step S25, the constructed IR code is transmitted to the TV set through the IR code transmitter to control the TV volume. The user can perform fine volume control by sliding his or her finger around position "6" after the above-mentioned operation. Note that it is assumed that the volume increasing direction is clockwise and the volume decreasing direction is counterclockwise.

[0067] In detecting the above-mentioned sliding operation, the controlled amount can be varied such that the variation width becomes larger as the sliding speed becomes higher, and vice versa. This sliding speed can be calculated from the position moving amount.

[0068] The above-mentioned steps are repeated to allow the user to operate the controller in an interactive manner more intuitively. If the next operating instruction is given for a predetermined period of time, the operation is considered to be ended. In this case, the procedure ends after step S27 to return the controller to the initial state.

[0069] Thus, the volume control operation of the controlled TV set performed by operating the ring-shaped operation part 7 of the remote controller through the above-mentioned sequence of operations is competed.

[0070] The following is a supplementary explanation about the sliding operation in

detecting the operated position on the operation part shown in FIG. 11.

[0071] Upon time setting, if the user wants to set the time in one minute increments, a finer scale will be required for the arrangement of operating positions. In this case, the results of calculating the above equation can be made finer by making the pitch of the scale finer, that is, by increasing the amount of operating data to be stored in the ROM 77, thus making smooth operation possible. For example, if the amount of operating data is increased five times, a direct operation instruction using up to 60 positions, five times the twelve positions, can be entered. Further, even if the number of operating positions is twelve, substantially the same result can be obtained by adding the calculation result of the sliding speed obtained by changing the controlled amount in such a manner, for example, to make the variation width larger as the sliding speed becomes higher, and vice versa.

[0072] Thus, even using the pressure sensor 43 having 2×2 devices, detection signals from the pressure sensor 43 are calculated and read from the ROM 77, respectively, so that the controller have resolution for detection signals larger in number than the devices of the pressure sensor 43, thereby enabling discrimination between a press on the circumference of the operation part 7 and sliding while holding pressed down or the sliding speed to derive the operating instruction.

[0073] FIGS. 16(A) to 16(F) are schematic views showing a first operational example of variable-speed VTR replay.

[0074] The following describes the operation and display example upon variable-speed VTR replay in FIG. 6. Suppose here that the user has already pressed position "12" on the ring-shaped operation part 7 that assumes the play (triangle mark) function in the same manner as the above-mentioned VTR operation, and the VTR is replaying a video. While the VTR is replaying a video, the user can slide his or her finger along the circumference of the ring-shaped operation part 7 to vary the replay speed, which is so-called variable-speed replay. For example, quarter-round clockwise sliding while lightly

pressing the ring-shape portion of the operation part 7 as shown in FIG. 16(A) is slow replay, half-round clockwise sliding motion shown in FIG. 16(B) is fast-forward, one-round clockwise sliding motion shown in FIG. 16(C) is faster fast-forward, quarter-round counterclockwise sliding motion shown in FIG. 16(D) is reverse slow replay, half-round counterclockwise sliding motion shown in FIG. 16(E) is rewind, and one-round counterclockwise sliding motion is fast rewind.

[0075] FIGS. 17(A) to 17(F) are schematic views showing a second operational example of variable-speed VTR replay.

[0076] For example, like the operational example shown in FIGS. 16(A) to 16(F), the VTR functionality can also be implemented such that sliding once clockwise around the ring-shaped operation part 7 as shown in FIG. 17(A) is slow replay, sliding twice clockwise as shown in FIG. 17(B) is fast-forward, sliding three times clockwise as shown in FIG. 17(C) is faster fast-forward, sliding once counterclockwise as shown in FIG. 17(D) is reverse slow replay, sliding twice counterclockwise as shown in FIG. 17(E) is rewind, and sliding three times counterclockwise as shown in FIG. 17(F) is fast rewind.

[0077] The time setting can also be done using sliding motion in a like manner.

[0078] The following describes a case of VTR programming or setting of TV ON/OFF time in FIG. 5. The example of FIG. 5 shows a case of setting 9:00 PM for the start time and 11:20 PM for the end time. The setting using sliding motion is as follows:

[0079] The AM/PM indicators are alternated by sliding a finger once around the ring-shaped portion of the operation part 7. Alternatively, position "12" can be double-clicked instead. For example, when the current time is in AM (before noon), the AM indicator is changed to PM by sliding the finger once clockwise or counterclockwise around the ring-shaped operation part.

[0080] After setting AM or PM, the start time is set. When the user presses position "9" on the operation part 7, the start time is set to 9:00. Immediately following this setting, long and short hands of a clock or watch appear on the display part 9 as shown in

FIG. 5(A). Then, to set the start minute, if the user slides his or her finger while lightly pressing the ring-shaped operation part 7 and stops it at position "12" as shown in FIG. 5(B), 0 minute is set and the clock hands point to 9:00 on the display part 9. After that, the display part 9 shows [End hour?] as shown in FIG. 5(C) to guide the setting of the end time. Next, the user sets the end time. After the AM/PM setting is done in the same manner as mentioned above, the user presses position "11" to set the end hour. Immediately following this setting, the long and short clock hands appear on the display part 9 to indicate 11:00 as shown in FIG. 5(C). Then, to set the end minute, if the user slides his or her finger from position "12" to position "4" while lightly pressing the ring-shaped operation part 7, the clock hands point to 11:20 on the display part 9 as shown in FIG. 5(D), and a recording time confirmation display appears on the display part 9. In the recording time confirmation display, the start and end times are shown in a character string, while the total recording time is graphically shown in a fan-like shape. In the above-mentioned operations, after setting the start and end times, the set times can be controlled finely in increments of five minutes or less by sliding the finger by a small angle around the ring-shaped operation part 7.

[0081] The user can set the date for one month, that is, 31 days, by sliding his or her finger three times at maximum around the ring-shaped operation part 7. For setting of day of the week, positions "1" to "7" can be assigned for Monday, ..., Sunday, respectively. Further, the remote controller itself can have a calendar function.

[0082] FIG. 18 is a perspective view showing a remote controller according to still another embodiment of the present invention. A point different from the embodiment of FIG. 3 is that an operation part 83 and a display part 81 are interchanged. In other words, the display part 81 is formed into a ring shape, and the operation part 83 is arranged inside the ring shape. The operation of each part is the same as that of the aforementioned embodiments. In this case, the user can enter an operation signal by pressing a peripheral portion of the operation part 83 having a substantially round shape

or a position on the display part 81, or sliding his or her finger while holding pressed down or changing the sliding speed.

[0083] FIG. 19 contains schematic views showing examples of display on the display part of the remote controller in FIG. 18. These display examples correspond to those in the embodiment of FIG. 4. In this case, since the display part 81 is arranged around the outer periphery of the operation part 83, band-like indications are mainly displayed on the display part 81 upon volume control or variable-speed VTR replay.

[0084] As described above, according to the embodiments, the user operates the circumference of the operation part divided into twelve areas like those for the hands of a clock or watch. This allows the user to recognize operating positions without much concern for the respective operating positions. The user can also operate the controller intuitively to directly select a receive channel or the like. Further, since the display part is provided within the operation part or around the outer periphery of the operation part to provide a display according to the operation performed, an easy-to-operate remote controller capable of preventing operation errors and providing operational guidance can be provided.

[0085]

[Effect of the Invention] As described above, according to the present invention, an intuitively operable remote controller can be provided.

[Brief Description of the Drawings]

[FIG. 1] It is a perspective view showing a remote controller according to a preferred embodiment of the present invention.

[FIG. 2] It contains schematic views (A) and (B) showing an example of display on a display part of the remote controller shown in FIG. 1.

[FIG. 3] It is a perspective view for explaining a case when the remote controller shown in FIG. 1 is set in a TV mode.

[FIG. 4] It contains schematic views (A) to (D) showing examples of display on the

display part of the remote controller according to the present invention.

[FIG. 5] It contains schematic views (A) to (E) showing an example of display on the display part upon timer setting such as recording programming.

[FIG. 6] It is a perspective view for explaining a case when the remote controller shown in FIG. 1 is set in a VTR mode.

[FIG. 7] It is a perspective view showing an exemplary structure of an operation part of the remote controller according to the present invention.

[FIG. 8] It is a side view of the operation part shown in FIG. 7.

[FIG. 9] It is a block diagram showing the structure of the remote controller according to the embodiment of the present invention.

[FIG. 10] It is a block diagram showing the structure of a signal processing part according to the embodiment shown in FIG. 9.

[FIG. 11] It is a flowchart for explaining the operation of the remote controller according to the present invention.

[FIG. 12] It is schematic view for explaining a method of detecting an operated position on the operation part.

[FIG. 13] It is a block diagram showing the structure of a remote controller according to another embodiment of the present invention.

[FIG. 14] It is a block diagram showing the structure of a signal processing part according to the embodiment shown in FIG. 13.

[FIG. 15] It is a flowchart for explaining the operation of the remote controller shown in FIG. 12.

[FIG. 16] It contains schematic views (A) to (F) showing a first operational example of variable-speed VTR replay.

[FIG. 17] It contains schematic views (A) to (F) showing a second operational example of variable-speed VTR replay.

[FIG. 18] It is a perspective view showing a remote controller according to still another

embodiment of the present invention.

[FIG. 19] It contains schematic views showing examples of display on the display part of the remote controller shown in FIG. 18.

[Description of Reference Numerals and Symbols]

1 ··· CASE, 3 ··· TV/VTR SELECT SWITCH, 5 ···POWER SWITCH, 7 ··· OPERATION PART, 9 ··· DISPLAY PART, 11 ··· KEY SWITCH, 13 ··· KEY SWITCH, 15 ··· KEY SWITCH, 17 ··· KEY SWITCH, 19 ··· KEY SWITCH, 21 ··· KEY SWITCH, 29 ··· TRANSPARENT PANEL, 31 ··· OPERATION PART SUPPORTING LEGS, 33 ··· LIQUID CRYSTAL PANEL, 35 ··· LIQUID CRYSTAL PANEL SUPPORTING LEGS, 37 ··· RIGID PLATE, 39 ··· SIGNAL INPUT LINE OF LIQUID CRYSTAL PANEL, 41 ··· SUPPORTING RUBBER LEGS, 43 ··· PRESSURE SENSOR, 45 ··· OUTPUT SIGNAL LINE OF PRESSURE SENSOR, 51 ··· MULTIPLEXER, 53 ··· A/D CONVERTER, 55 ··· X-DIRECTIONAL (HORIZONTAL) INDICATING AMOUNT DETECTION PART, 57 ··· Y-DIRECTIONAL (VERTICAL) INDICATING AMOUNT DETECTION PART, 59 ··· INDICATING DIRECTION DETECTION PART, 61 ··· INDICATING ANGLE CALCULATION PART, 63 ··· DISPLAY SELECTING/SWITCHING PART, 65 ··· DISPLAY SCREEN CONSTRUCTING PART, 67 ··· IR CODE CONSTRUCTING PART, 69 ··· SIGNAL PROCESSING PART, 71 ··· MICROPROCESSOR, 73 ··· ROM, 75 ··· RAM, 77 ··· ROM, 81 ···DISPLAY PART, 83 ···OPERATION PART.